REMARKS

Response to the Objection to Drawings

In the April 20, 2006 Office Action, the Examiner reiterated previous objection to the drawings of the present application under 37 C.F.R. §1.83(a) for alleged failure to show every feature of the invention specified in the claims.

Specifically, the Examiner asserted that the drawings of the instant specification does not illustrate a Si/SiC interface having an abrupt change in C concentration of more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å, as recited by claims 29, 32, 33, 34, and 60 and their respective dependent claims, and that the replacement drawing for Fig. 2 and the Declaration signed by Dr. Jack Oon Chu, as filed with the previous response, are still insufficient to overcome the drawing objection.

Applicants respectfully traverse the Examiner's drawing objection, for the following reasons:

First, the requirement of 37 C.F.R. §1.83(a) has never meant to be taken in an absolute manner. Instead, it is limited by whether drawings are necessary for understanding the claimed subject matter and whether the nature of the claimed subject matter admits of illustration by drawing.

35 U.S.C. §113, on the basis of which 37 C.F.R. §1.83(a) was enacted[1], expressly provides that the applicant shall furnish a drawing when it is "*necessary for the understanding of the subject matter sought to be patented.*" It further states that "[w]hen *the nature of such subject matter admits of illustration by drawing* and the applicant has not furnished such a drawing, the Director may require its submission within a time period of not less than two months from the sending of a notice thereof," which indicates that the nature of such subject matter should be considered

[1] Please note that 37 C.F.R. §1.83(a) is a regulation or rule of practice that was enabled by and enacted on the basis of 35 U.S.C. §113, which represents the statutory authority behind 37 C.F.R. §1.83(a) and which proceeds 37 C.F.R. §1.83(a).

when deciding whether a drawing is required for the claimed subject matter or not. Therefore, the language of 37 C.F.R. §1.83(a) should be read in light of 35 U.S.C. §113, and the requirement of 37 C.F.R. §1.83(a) is limited by whether the drawings are necessary for understanding the claimed subject matter and whether the nature of the claimed subject matter admits of illustration by drawing.

It is well recognized by the USPTO that illustration of certain features of a claimed invention is not necessary for the understanding of the claimed invention, and the USPTO has always excused the drawing requirement in such cases. For example, it has been a USPTO practice to treat an application that claims a process or method as an application for which a drawing is not necessary, and the same practice has been followed in treating applications that claim compositions. Further, USPTO has expressly excused the drawing requirement for applications that claim: (1) coated articles or products; (2) articles made from a particular material or composition; (3) laminated structures; and (4) articles, apparatus, or systems where sole distinguishing feature is presence of a particle material, on the basis that drawings are not necessary for the understanding of such inventions. See MPEP §601.01(f) for "Applications Filed Without Drawings."

Pending claims of the present application clearly recite a layered structure containing an interface having an abrupt change in C concentration of more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å. Such a layered structure with the recited abrupt change in C concentration can be readily understood without drawings, which is evidenced by the fact that the Examiner not only understood the claimed structure, but also have already conducted searches for it and made rejections against it.

Therefore, **it is not necessary for the Application to provide drawings to specifically show such a laminated structure with the abrupt change in C concentration**, consistent with the provision of 35 U.S.C. §113 and the USPTO practice as described in MPEP §601.01(f).

Further, **the abrupt change in C concentration as recited by the pending claims of the present invention cannot be measured by any currently available analytical tool**.

As stated by Dr. Jack Oon Chu during a teleconference with the Examiner and the undersigned attorney on July 5, 2006, and as further explained in a newly signed Declaration by Dr. Jack Oon Chu (a copy of which is enclosed herewith for the Examiner's review), there is currently no analytical tool that can be used to measure such an abrupt carbon concentration change, although the claimed layered structure has been successfully formed by using an ultra high vacuum chemical vapor deposition (UHV-CVD) process, and the abruptness of the C concentration change can be readily inferred from the deposition conditions. Specifically, Dr. Chu explained in detail why it is certain that the claimed abruptness of C concentration change has been achieved in the layered structure formed by UHV-CVD and why secondary ion mass spectrometry (SIMS) and transmission electron microscopy (TEM) cannot show the abruptness of the carbon concentration change at the interfaces between single crystal layers in the formed layered structure. In other words, Dr. Chu's Declaration not only testifies to the operability of the claimed invention, but also testifies to the current inability of measuring the claimed abrupt change in C concentration.

Based on the foregoing, Applicants submit that the drawing requirement was improperly applied to this case and respectfully request the Examiner to withdraw the drawing requirement.

Allowable Claims 33-41

In the April 20, 2006 Office Action, the Examiner indicated that claims 33-38, 40 and 41 would be allowable, subject to a successful removal of the drawing objection (see Office Action, page 9, paragraphs (a) and (b)).

As stated hereinabove, the drawing requirement was improperly applied to this case, and the removal of the drawing objection has been hereby requested. Correspondingly, claims 33-38, 40 and 41 are allowable.

Further, the Examiner objected to claim 39 for depending from a rejected base claim and indicated that claim 29 would be allowable if rewritten in independent form and subject to a successful removal of the drawing objection (see Office Action, page 9, paragraph (b)).

Correspondingly, claim 39 has been rewritten herein as suggested by the Examiner, and in conjunction with the removal of the drawing objection as requested hereinabove, claim 39 is therefore allowable.

Response to §103 Rejections of Claims 29, 32 and 60

In the April 20, 2006 Office Action, the Examiner reiterated previous rejection of claims 29, 32 and 60 under 35 USC §103(a) for alleged obviousness over Swanson et al. U.S. Patent No. 6,552,375 (hereinafter "Swanson") in view of Edmond U.S. Patent No. 5,601,972.

Applicants traverse the §103 rejections of claims 2932 and 60, for the following reasons:

Claims 29 (from which claim 32 depend) and claim 60 both positively recite an interface that is defined by an upper surface of **single crystalline Si** and a layer of **single crystalline SiC (as recited by claims 29 and 60) or SiGeC (as recited by claim 60 only)** and has **an abrupt change in C concentration of more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å**.

In the newly signed Declaration, Dr. Jack Oon Chu testified to the fact that prior to the claimed invention of the present application, carbon concentration changes between adjacent single crystal silicon-containing layers have never been achieved to the level of more than 1 x 10^{18}

atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å, due to several reasons. First, such an abrupt carbon concentration change severely disrupted the crystal lattice during epitaxial growth and formed defects in the deposited layers. Second, when the carbon concentration in a silicon-containing layer exceeded a critical value, i.e., the equilibrium solid solubility, beta-SiC started to precipitate out of the crystal lattice. Consequently, polycrystalline SiC layers were formed, instead of single crystalline SiC layers (see the Declaration, paragraph 12). Dr. Chu further stated in the Declaration that the present invention successfully achieves the desired abrupt carbon concentration change, but without affecting the single crystalline characteristic or quality of the deposited SiC layers (see Declaration, paragraph 13).

Therefore, **the claimed abrupt change of carbon concentration at the layer interface and the single crystalline characteristic of the deposited layers are both important features of the present invention**.

The Swanson reference only discloses an interface defined by SiC layer 218 and Si layer 216 (see Figure 2 of Swanson). In the April 10, 2006 Office Action, the Examiner asserted that this interface has the abrupt change of carbon concentration recited by claims 29, 32, and 60 of the present application, i.e., more than 1×10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å (see Office Action, page 5, lines 1-12).

However, **nothing in Swanson discloses, or even contemplates, that the SiC layer 218 is single crystalline**. On the contrary, Swanson discloses that the SiC layer 218 is a part of the polysilicon emitter 226 (see Swanson, column 6, lines 66-67, and column 7, lines 1-4), which implies that the SiC layer 218 disclosed by Swanson is polycrystalline, instead of single crystalline.

In the April 20, 2006 Office Action, the Examiner conceded to the above-described deficiency of Swanson, but attempted to remedy such a deficiency by citing Edmond, asserting that Edmond discloses a single crystalline SiC layer and it would be obvious to substitute the layer 218 of Swanson with the single crystalline SiC layer disclosed by Edmond. Specifically, the Examiner

stated that Edmond discloses the "well-known use of epitaxy... in producing single crystalline SiC layers in the production of abrupt junctions" (see Office Action, page 10, second last paragraph).

However, Edmond discloses single crystalline SiC layers having different types of carriers (i.e., electrons or holes) and different carrier concentrations, which form an abrupt p-n junction (see Edmond, Abstract and column 5, lines 63-64).

It is well known that the p-type carriers, i.e., holes, are introduced by doping with atoms having a lesser number of electrons per atom in the valance positions than that of the semiconductor material itself, and the n-type carriers, i.e., electrons, are introduced by doping with atoms having a greater number of electrons per atom in the valance positions than that of the semiconductor material itself (see Edmond, column 6, lines 5-13). Because Si and C both are Group IVA elements and both have 4 electrons per atom in the valance positions, Group IIIA dopant species (e.g., B, Al, Ga, and In, which have only 3 electrons per atom in the valance positions) have to be used to form the p-type carriers or holes in the SiC layers, and Group VA dopant species (e.g., N, P, As, and Sb, which have 5 electrons per atom in the valance positions) have to be used to form the n-type carries or electrons in the SiC layers.

Therefore, it is clear that Edmond only discloses single crystalline SiC layers with different concentrations of Group IIIA (such as B, Al, Ga, and In) or Group IVA (such as N, P, As, and Sb) dopant species for establishing abrupt p-n junctions, which is **completely different** from the abrupt carbon concentration changes recited by claims 29, 32, and 60 of the present application.

In fact, nothing in Edmond teaches or even suggests that the concentration of carbon (which is a Group IVA element) in the single crystalline SiC layers changes at all, much less an abrupt change of carbon concentration of more than 1×10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å.

Therefore, **Edmond does not provide any derivative basis for formation of single crystalline SiC layers with the abrupt carbon concentration change at the interfaces**, as positively recited by claims 29, 32, and 60 of the present application.

The proposed substitution of layer 218 of Swanson with the single crystalline SiC layer of Edmond, as suggested by the Examiner in the April 10, 2006 Office Action, **therefore is still not supported by any reasonable expectation of success**. One cannot simply lift the single crystalline SiC layer of Edmond off its SiC base layer and glue it to the Si layer 216 of Swanson. Instead, a deposition process has to be used for growing the single crystalline SiC layer of Edmond over the Si layer 216 of Swanson, and it is uncertain whether such a deposition process can achieve the claimed abrupt carbon concentration change (i.e., more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å) without disrupting the single crystalline characteristic of the SiC layer.

Therefore, claims 29, 32, and 60 of the present application patentably distinguish over both Swanson and Edmond, and Applicant respectfully request the Examiner to reconsider, and upon reconsideration to withdraw, the rejections of claims 29, 32, and 60.

CONCLUSION

Based on the foregoing, claims 29, 32-41, and 60 as amended herein are in condition for allowance. Issue of a Notice of Allowance for the application is therefore requested.

If any issues remain outstanding, incident to the formal allowance of the application, the Examiner is requested to contact the undersigned attorney at (516) 742-4343 to discuss same, in order that this application may be allowed and passed to issue at an early date.

Respectfully submitted,

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